Murchison Gold Project

Works Approval Supporting Information Document

Category 85 Sewage Facility

Tenements	**M51/870**
Tenement Holder	**Andy Well Mining Pty Ltd**
Ownership	**100%**

25 October 2024

Executive Summary

Meeka Metals has recently purchase a Waste Water Treatment Plant (WWTP) from Kalium Lakes Potash Pty Ltd. The Plant was in operation at the Kalium Lakes site, prior to the project going into administration. The plan will treat up to 35kl per day at the Andy Well site. This will allow for a workforce of up to 140 people at the site.

Meeka has obtained the Installation, Operation and Maintenance manual for the WWTP, which will be used to aid in the installation, commissioning and on-going operation of the plant. The plant has been run successfully in the past and it is expected to perform to the required levels at Andy Well.

The plant will operate to treat sewage in batches, with sludge removed and disposed of periodically, while the remaining water is subject to both anoxic and aerobic treatment to remove nitrates and phosphates to produce a clean final effluent product, which will be sent to an irrigation spray field.

The past works approvals for the plant were obtained to understand the performance of the plant and set operating limits and targets. These are found within Table 3, and mirror the revised operating limits as stated in the Kalium Lakes Potash Pty Ltd Works Approval (W6149/2018/1).

The Project has established a commissioning plan based on the advice presented in Appendix 1, and subsequent monitoring has been developed. Monitoring will initially occur three days per week, coinciding with flights from site back to Perth. Samples will be taken prior to the flight and will be at a NATA accredited laboratory within 5 hours of the sampling time. This level of monitoring shall occur until such a time when the plant appears to be running as per the manufacturer's specification. At this time monitoring frequency will be reduced to weekly for a short period, before settling as a monthly sampling effort.

All results will be maintained on site and in the Perth office and will be available upon request. Results will be published annually in the Annual Environmental and Annual Compliance Reports.

The receiving environment has been subject to all necessary studies and the plant poses no unacceptable risks. A risk register has been developed to capture the potential risks and outline the management practices to be implemented.

It is the opinion of Meeka Metals that the WWTP can be installed and operated throughout the life of the operation with no significant environmental impacts, and that once commissioned the plant will operate to produce a clean effluent suitable for irrigation into the environment.

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1 Introduction

1.1 Application Type

This Works Approval application is for the following category:

Sewage Facility: Premises

(b) From which treated sewage is discharged onto land or into waters

1.2 Applicant Details

The Murchison Gold Project (MGP) is located on M51/882, M51/870 and L51/97, held by Andy Well Mining Pty Ltd (ABN 68 158 108 895). Andy Well mining is a fully owned subsidiary of Meeka Metals limited (ABN 23 080 939 135).

All correspondence regarding this application should be forwarded to;

The tenement details are outlined in the table below.

Table 1 Project Tenements

Tenement ID	Tenement Holder	Grant	Expiry	Area (ha)
M51/882	Andy Well Mining Pty Ltd	31/08/2020	30/08/2041	3475.44
M51/870	Andy Well Mining Pty Ltd	27/04/2012	26/04/2033	1109.5
L51/97	Andy Well Mining Pty Ltd	05/12/2017	04/12/2038	95.44

2 Premises Details

2.1 Project Description

The MGP is the name allocated to all the mining and exploration areas that form part of the granted tenure owned by Meeka in the Murchison region. Within this broader project description is the existing Andy Well Project (AW) and the new Gnaweeda Project (GP). Within each respective sites exists individual mining areas. This breakdown is shown below:

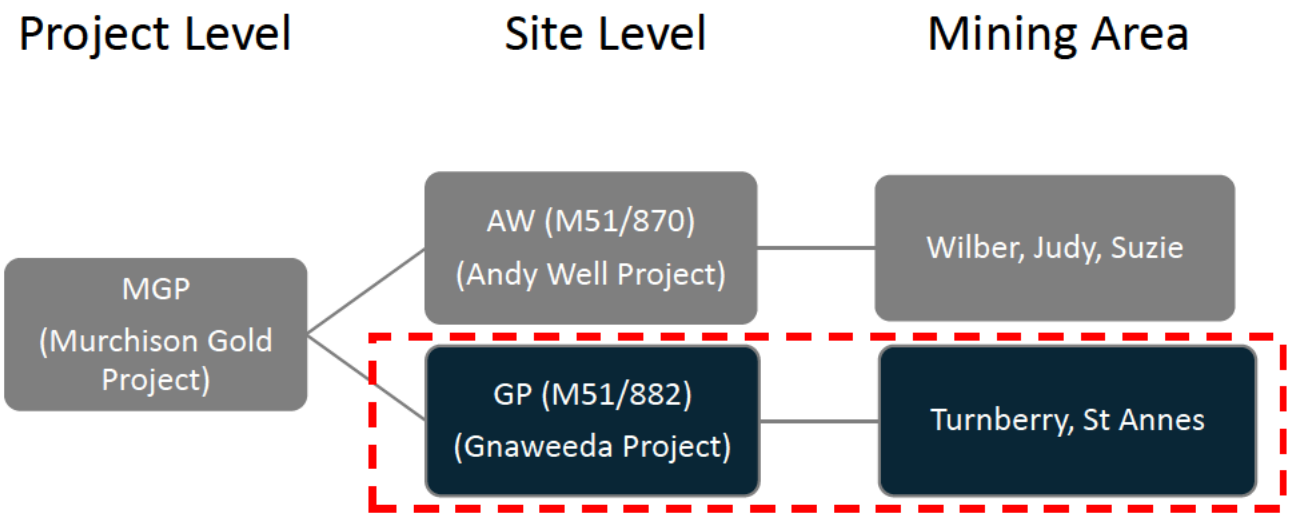

Figure 1 Project Description

2.2 Location

The MGP is located 45 km north of the town of Meekatharra in the Murchison region of Western Australia (WA), adjacent to the Great Northern Highway (Figure 2). The Gnaweeda Project is located entirely within mining tenement M51/882. The development envelope overlies two pastoral leases. The Project is situated within the registered Native Title area of the Yugunga Nya People. An accommodation camp on M51/870 is proposed which will support activities over the life of the project.

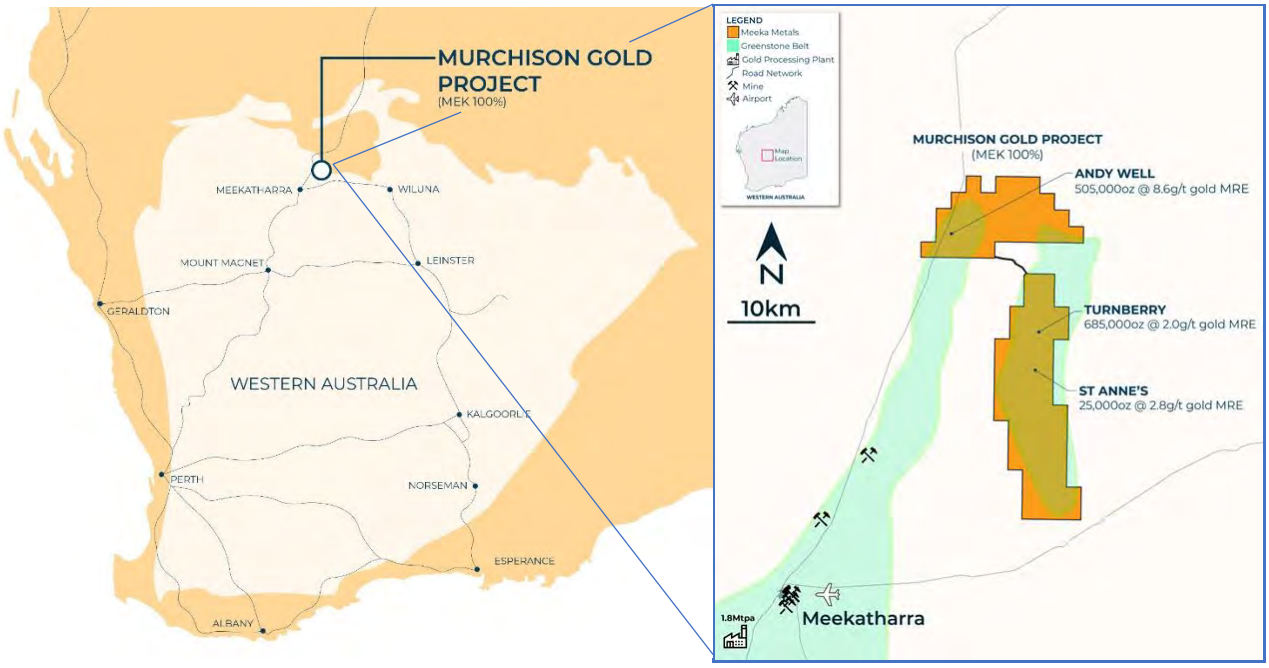

Figure 2 MGP Project location and Tenure

2.3 Site Layout

The Murchison Gold Project is located across three tenements, M51/880, M51/870 and L51/91. The Mine village is located on M51/870 and is seen in Figure 3. The Project has received DEMIRS approval and is currently under construction.

The Mine village was originally sized to be for less than 100 people and the associated wastewater discharged were calculated at being below the 20KL per day threshold for requiring works approval and licencing. Since this decision was made, Meeka has revised the operation and has upsized the village to a final installation of up to 136 rooms which increases the overall wastewater production.

In September 2024 Meeka purchased a wastewater treatment plant (WWTP) with the capacity to treat up to 35kl per day. This infrastructure exceeds the 20kl per day threshold for requiring works approval. This application is for 35kl per day, which allows for water consumption of 269L per day per room.

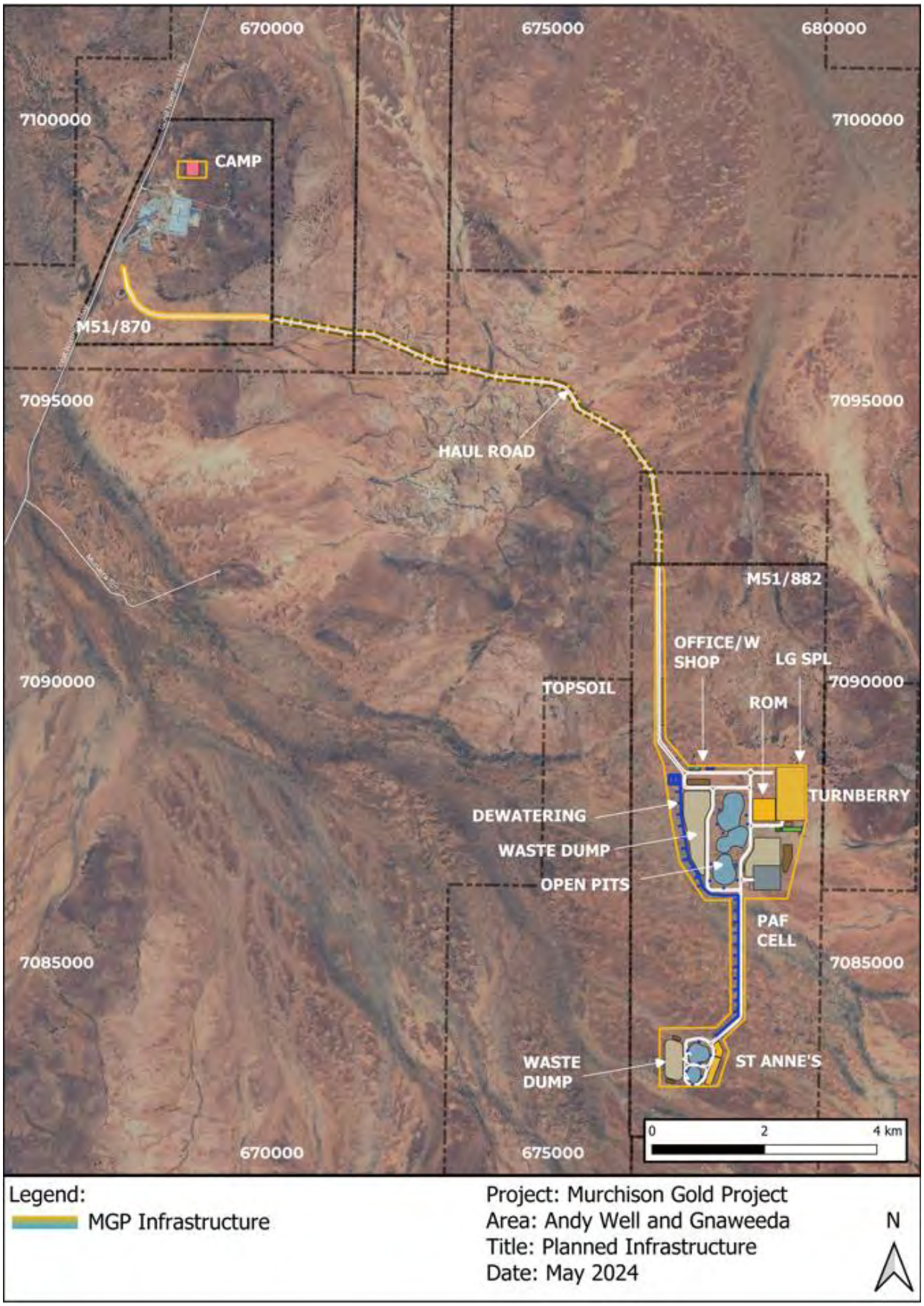

Figure 3 MGP Project Layout

3 Wastewater Treatment Plant Layout

Figures 4 and 5 show the layout of the WWTP and the proposed spray field. The key components of the WWTP are as follows;

- 2mm inlet bar screen for the removal of inorganics from camp influent
- Balance tank, which acts as a buffer during periods of peak flow
- Balance/mixer pump for the transfer of wastewater to the SBR tank
- Poly aluminium chloride (PAC) dosing pump for the removal of phosphorus
- Sucrose dosing pump for the removal of external carbon
- SBR tank for the treatment of wastewater including the removal of BOD, complete nitrification, de-nitrification and clarification (TSS removal)
- Submersible aerator/mixer to supply oxygen to the SBR tank for biological treatment and the mixing suspension of solids during the anoxic phase
- A decant pump for the removal of clear effluent from the top of the SBR tank after the settling period
- Sludge pump for the transfer of waste sludge from the SBR tank to the sludge tank
- Sodium hypochlorite dosing pump to sterilise treated effluent
- Irrigation tank to hold treated effluent prior to disposal to the spray field
- Sludge tank for the storage of sludge before periodic removal and disposal

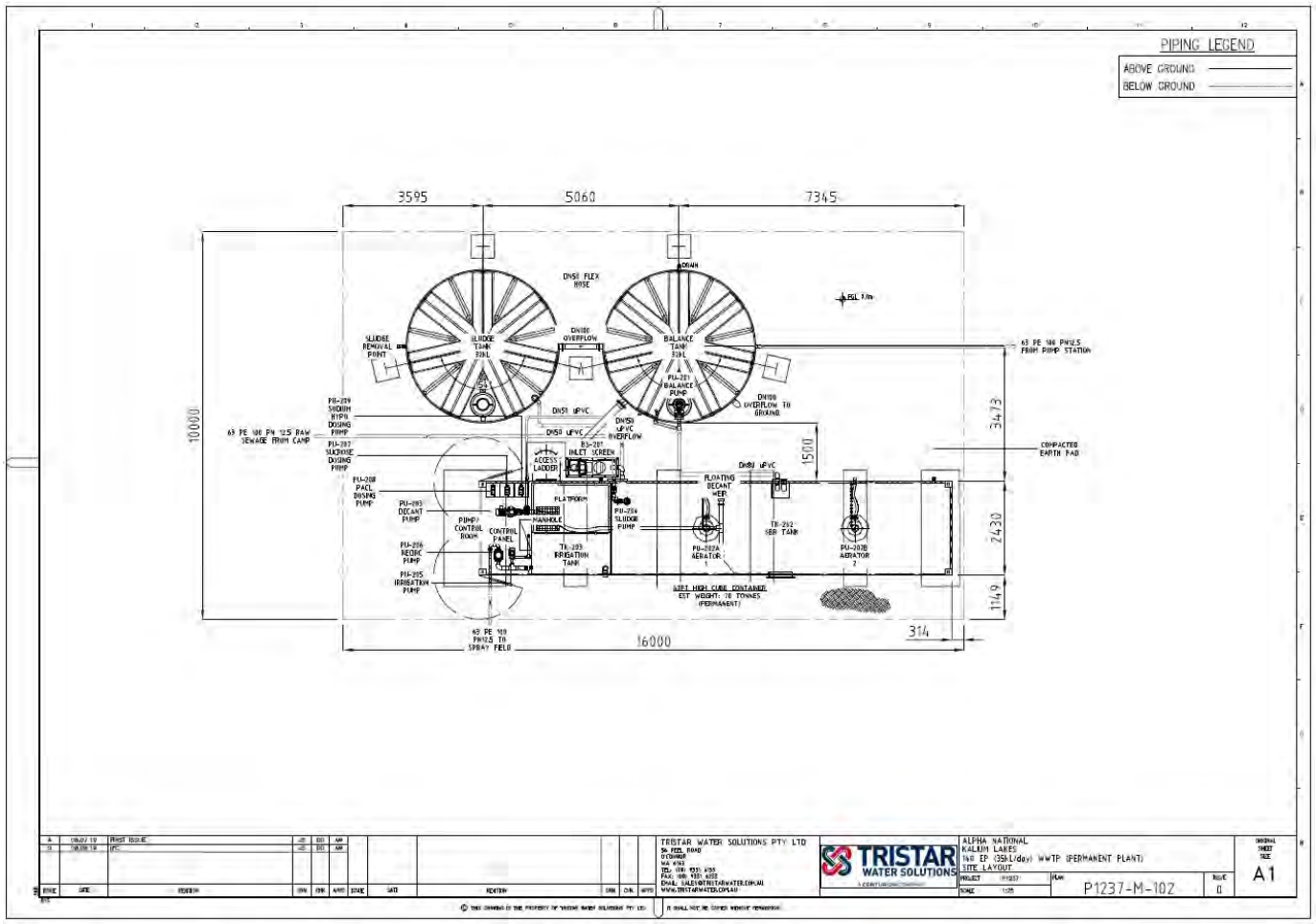

Figure 4 WWTP Plant Layout

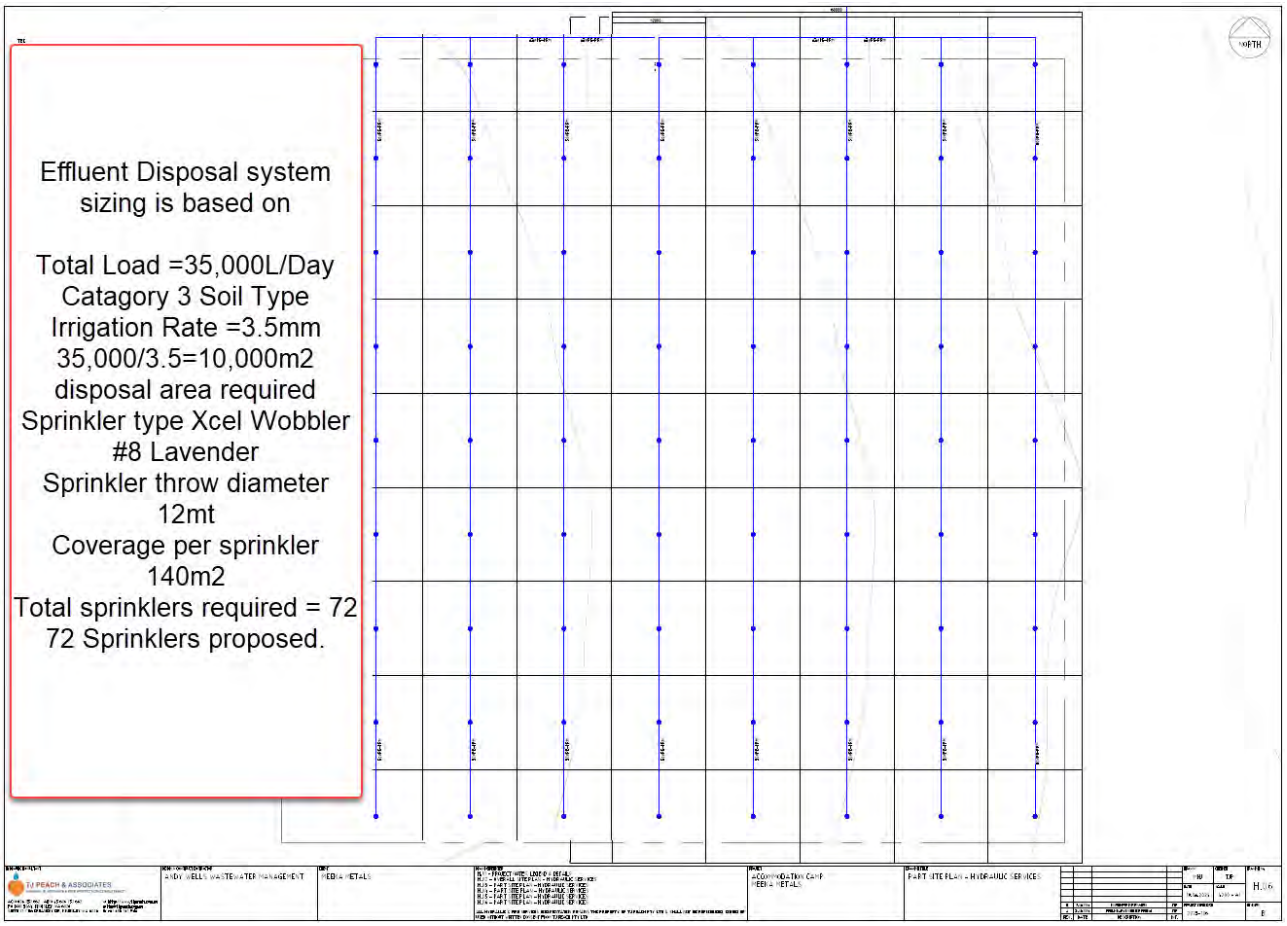

Figure 5 Spray field Layout

4 Project Description

4.1 Introduction

Meeka purchased a sequence batch reactor WWTP from Kalium Lakes. The WWTP can treat up to 35kl per day to produce Class C (Low Risk) effluent for disposal to the irrigation spray field of 1ha.

The WWTP is comprised of;

- Sewage pump station which transfers sewage from the village to the balance tank
- Inlet bar screen which screens the sewage before it enters the balance tanks.
- A single process train which is comprised of a sequence batch reactor (SBR) tank and irrigation tank
- Irrigation spray field
- Associated pumps, aerators and dosing equipment

Sewage will be treated in batches. The treatment process follows a number of sequences. The treatment itself is therefore described as an SBR process.

The treated effluent is then stored in irrigation tanks where it is disinfected prior to disposal to the irrigation spray field.

Sludge from the process is transferred to a sludge tank where it is periodically pumped out by an approved transporter for disposal offsite at an approved landfill facility.

4.2 Waste Water Composition

The influent entering the wastewater treatment plant will reflect the characteristics of its source. For mine camp wastewater, the principal producers are showers, wash basins, toilet facilities, laundries and kitchens. Each of these facilities produces a characteristic effluent which combines together to be the raw sewage feeding to the wastewater treatment plant via the sewage pump stations.

Soluble Biodegradable Substances: Wastewater from the toilet facilities and kitchen contain large amounts of solids and organic matter, which together make up a large proportion of the biological and biochemical oxygen demand (BOD) and suspended solids (SS) load on the wastewater treatment plant.

Fresh wastewater also contains an amount of ammonia (NH_3) and this contributes to part of the total nitrogen (TN) content of the wastewater. Another nitrogen source is from the reduction of ammonia, nitrate or protein from food sources and faecal matter. Phosphorus (P) within wastewater is mainly due to detergent used within the laundries or from dish washers.

Non-Biodegradable Solids: Inorganic materials such as plastics, fabrics, contraceptives and sanitary items may also be experienced in large quantities. As these materials can cause blockages and major wear to pumps, Site management must implement procedures to prevent these materials from entering the system.

The Village also includes kitchens and laundries. The wastewater from kitchens and laundries contains a high amount of solids, detergents, cleaners, small amounts of oil and grease as well as organic matter. Kitchen waste can be extremely variable and very strong depending on the amount discharged to the sewer.

The composition and volume of the wastewater will vary, depending on the number of people present in the camp and the usage of facilities there. This means that considerable variability that should be expected in both the strength and volume of the raw wastewater entering the plant.

This wastewater treatment plant is an aerated system that provides integral nitrification, denitrification and phosphorous removal. The nitrification and de-nitrification process is achieved within the SBR tank.

This plant has been designed to treat a wastewater with characteristics as listed in Table 2. Wastewater characteristics and/or hydraulic loading outside of range specified in Table 2 are to be avoided and Tristar Water Solutions should be informed immediately should this occur.

Table 2 Influent- Wastewater specifications

Parameter	Maximum	Unit
No of people	Up to 140	People
Hydraulic Load	250	Litres per day
Total Daily Flow	Up to 35	M^3/day
TSS	350	mg/l
BOD	350	mg/l
Total Nitrogen	60	mg/l
Total Phosphorus	14	mg/l
pH	6.5-8.5	pH units

4.3 Management of the System

Management of the sewage catchment systems is usually the responsibility of designated staff in charge of the routine operation and maintenance of the wastewater treatment plant. The performance of the wastewater treatment plant also relies on good housekeeping practices. There is a duty of care to ensure that a minimum number of undesirable chemicals and material are allowed into the system.

4.3.1 Chemicals

There are a number of chemicals that should not be allowed into the WWTP under any circumstances

- Herbicides/ pesticides/ insecticides
- Petrol/ diesel/ oil
- Organic solvents (turpentine, kerosene)
- Large quantities of chlorine
- Acids or caustic material
- Heavy metals
- Chemicals toxic to biological life

The village will utilise many disinfectants and cleaners as part of maintaining a safe living environment. Where these chemicals are used sparingly and within normal operational limits there should be little impacts of the operation of the SBR plant. These chemicals include:

- Household disinfectants
- Washing powders and detergents
- Bleach
- Surface cleaners
- VHD degreaser
- Automatic dishwasher detergents
- Fabric softeners
- Sanitizers

The key factors involved with many of the active ingredients in these products are concentration and exposure time. Low concentrations over an extended period of time can have similar toxic effects on the treatment plant as a shock load of high concentration. It is generally accepted that the lower concentration is preferable. Sensible practices in the use and disposal of these products and the effective management of cleaning routines should minimize the impact of these products on the performance of the plant.

The operation of the WWTP will be optimised by the use of environmentally friendly or safe versions of various chemicals. Over the last decade or so, these chemicals have become more widespread, and their effectiveness has become similar to more harsh chemicals. To ensure the WWTP runs as optimally as possible, considerations for the use of chemicals on site will be weighed based on the following:

- Low environmental impact due to high bio-degradability
- Low eco-toxicity
- Low oral, ocular and dermal toxicity
- Impact on wastewater treatment facilities
- Cost of product compared to similar alternatives
- Impact on receiving environment

4.3.2 Management of Solids

Excess solids have the potential to reduce the efficacy of the WWTP. To manage solids the following measures are proposed:

- Food scraps are disposed of in bins prior to washing dishes to reduce the potential for solids entering the waste stream
- Fats from cooking are allowed to cool and solidify and are then placed in bins to prevent these entering the WWTP
- Grease traps are in place to capture fats and greases to prevent these entering the WWTP
- Large volumes of hot water are not allowed to enter the waste water stream to ensure the efficacy of grease traps is maintained
- Wastes such as napkins and sanitary products are segregated and not sent to the WWTP
- Floors are mopped and cleaned prior to being hosed sown to prevent sands and rocks entering the WWTP

4.3.3 Final Effluent Quality

The DOH effluent standards require that discharge from the wastewater treatment plant is within pre-set limits. The effluent quality for the plant is listed in Table 3.

Table 3 Final Effluent Quality

Parameter	Maximum	Unit
BOD	<20	mg/l
TSS	<30	mg/l
pH	6.5-8.5	pH Units
Chlorine Residual	0.2-2.0	mg/l
E.coli	<1000	Cfu/100ml

5 Disturbance

The disturbance associated with the Project is less than 1 ha. This disturbance breakdown is outlined in Table 2. A 1.6 ha Spray field is also required, but this is not considered to be disturbance, as the pipework and sprinklers will all be laid over the top of the ground.

Table 4 Project Disturbance

Tenement	Infrastructure	Footprint (Ha)
M51/870	WWTP installation	1
Total Disturbance		1

6 Other DWER Approvals

A 5C licence to take water has been obtained for the Project (GWL17556-4). The licence is for an annual allocation of 2GL. The licence is in force until October 24th 2026. The licence will be renewed prior to its expiry.

A 26D licence issued under the *Rights in Water and Irrigation Act* 1914 (WA) will be required to install the dewatering bores around the pits. This licence will be applied for prior to the commencement of mining operations.

The Andy Well mine has a current site licence (L8698/2012/1) this licence is for the treatment of ore and generation of tailings, a landfill and mine dewatering. Once commissioned it is anticipated that the WWTP will be added to the licence to allow for ongoing operation and management.

7 Other Approvals and Consultation

7.1 Other Approvals

The Andy Well Mine currently has a series of approvals in place that were granted between 2012 and 2017. These approvals allow for open pit and underground mining, the construction of waste rock dumps, a TSF and the processing facility.

No further approvals are required to operate the mine.

7.2 Consultation

The Project has undertaken consultation with all the key stakeholders associated with the Murchison Gold Project. A summary of the consultation is provided in the sections below.

7.2.1 DWER

An initial meeting was held between representatives from Meeka and DWER on October 17, 2023. At the meeting the Project was introduced, and the various items within the remit of DWER were discussed, mainly regarding the Gnaweeda Project.

A second meeting was held with DWER on September 9, 2024, to discuss further Project approvals. In this meeting the topic of village wastewater management was discussed and the various disposal methods being considered were discussed. The need for a works approval was identified and this document forms the basis of that approval.

7.2.2 DEMIRS

A meeting with DEMIRS was held on the 12th of September 2024 in which the village wastewater management was discussed. The Village was approved as part of the Gnaweeda Mining proposal and DEMIRS were supportive of the installation of a WWTP, but considered their role in the approvals had been satisfied.

7.2.3 YMAC

An existing Native Title Mining Agreement is in place for the entire Murchison Gold Project. YMAC were advised by email that the Project was commencing the approvals process. Under the agreement, Andy Well Mining Pty Ltd has issued an Activity Notice to YMAC in accordance with the agreement.

7.2.4 Killara and Yoothapina Stations

The Project sits across two pastoral stations. Both stations are utilised for various work by the Project, and both are supportive of the operation commencing. There is regular and ongoing contact between Meeka and the stations, and a good relationship has been formed.

7.2.5 Meekatharra Shire

The Shires has been contacted and told that the Gnaweeda Project approvals had commenced. The shire is supportive of the Project and wants to find ways for local businesses to become involved

where possible. The shire encouraged us to maintain this relationship as we progress our approvals with DoH and in relation to building permits, as required.

7.2.6 Department of Health

Approval for the WWTP will be sought from the DOH. This approval is currently being developed and will be submitted for concurrent assessment with eh Works Approval.

8 Applicant History

Andy Well Mining Pty Ltd was established to enable the mining of the Andy Well mine located on M51/870. The company currently holds a Part V licence over the mine, L8698/2012/1 which covers the following;

- Category 5 Processing or beneficiation of metallic or non-metallic ore (design capacity of 50,000 tonnes or more per year)
- Category 6 Mine dewatering over 50,000 tonnes per year.
- Category 64 Landfill

This licence remains in force and will be required when the Andy Well site is taken out of care and maintenance as part of the greater Murchison Gold Project (Stage 2).

In 2024 Andy Well Mining was granted a Works Approval for dewatering at the Gnaweeda mine (W6894/2024/1). This approval allows for the dewatering and environmental discharge of up to 1.6GL per year of high-quality groundwater. The works approval also permits a landfill with an annual disposal limit of up to 500t per year.

As per of the Andy Well Mine restart, the company has a works approval currently under assessment for in pit tailings disposal into the Suzie Pit. This approval is currently under assessment.

9 Emissions and Discharges

The main emission associated with this application is the discharge of treated effluent to the environment. Other minor emissions will include odour and dust during construction

9.1 Operation of the WWTP

Appendix 1 has been developed by Tristar Water Solutions and contains the operating procedure for the SRB WWTP. The procedure will be used to run the plant in the manner specified by the plant designer and manufacturer.

10 Environmental Siting and Location

10.1 Climate

The Murchison region is described as an arid climate characterised by summer and winter rainfall with annual totals rarely exceeding 200 millimetres (mm)). The climate is typical of a semi-desert tropical climate characterised by hot summers and relatively warm, dry winters (BoM 2016).

Meekatharra Airport (station number 007045), approximately 40 km south west of the Study Area, is the nearest Bureau of Meteorology (BoM) weather station, which documents long term climate data (BoM 2023). The mean annual rainfall recorded at Meekatharra Airport is 239 mm with the majority received between January and March each year, with a secondary peak between May and July. Peak rainfall is recorded in February with a secondary peak in June (BoM 2023). The hottest maximum temperatures occur between November and March, with the coldest minimums occurring between May and August (BoM 2023).

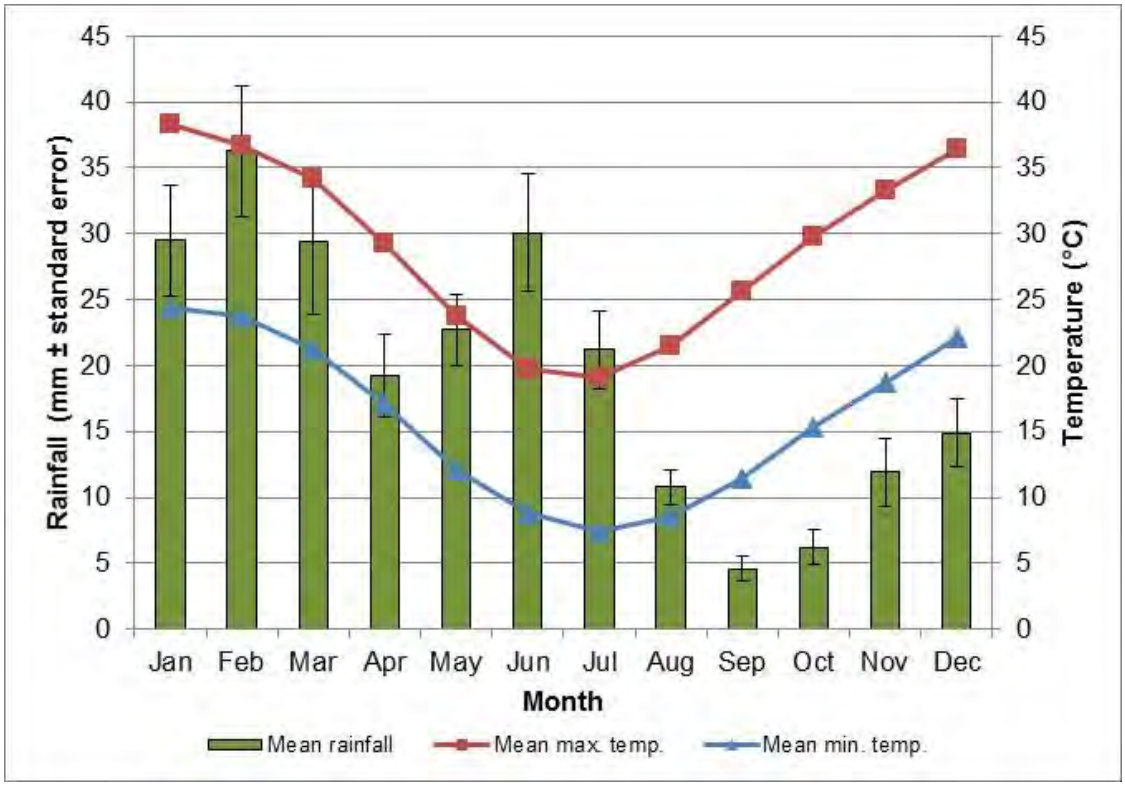

Figure 6 Project Climate Data (BOM, 2023)

10.2 Flora and Vegetation

10.2.1 Regional Vegetation

The Murchison region of the Eremaean Botanical Province (Beard 1976) is typified by plants from the families Fabaceae (*Acacia* spp.), Myrtaceae (*Eucalyptus* spp.), Scrophulariaceae (*Eremophila* spp.), Chenopodiaceae (samphires, bluebushes and saltbushes), Asteraceae (daisies) and Poaceae (grasses). The region is characterised by the widespread presence of mulga (*Acacia aneura*) communities (Beard 1990). *Acacia aneura*, which thrives in harsh environments, is a variable species, forming woodlands on the plains and reducing to scrub on the rises and hills (Beard 1990) (Mattiske Consulting 2011).

The vegetation of the convergence of the West and East Murchison subregions is dominated by Mulga woodland and Mulga shrubland, with *Eremophila* spp being the most abundant species of undershrub (Beard 1990). These woodlands and shrublands are often rich in ephemeral species (plants with short life cycles that are very dependent on favourable conditions such as rainfall) and may also support perennial and annual grasses. Hummock grasslands and chenopod communities associated with salt lake systems are less frequently present (Cowan 2001: Desmond et al. 2001) (Mattiske Consulting 2011).

10.2.2 Local Vegetation

The vegetation of the Project area can be broadly described as “Mulga” (*Acacia aneura* and spp.) or *Acacia* semi-desert scrub, consisting of *Acacia* groves roughly aligned to contours within an otherwise treeless broad, flat hardpan wash plain supporting low open scrub of *Eremophila* spp (SWC, 2012).

Mattiske Consulting conducted a flora and vegetation survey of the Project area from 11th to 14th April 2011. A total of 69 sampling sites were surveyed, covering the greater Andy Well exploration tenement (E15/1217) to include the proposed mining and infrastructure areas within the Mining Lease M51/870 application boundary and land access areas extending the entire EL boundary (see Figure 2). The survey effort after reasonable rains was considered more than adequate to meet the EPA Guidance Statement 51 standards (EPA 2004) (Mattiske Consulting 2011).

Ten plant communities were recorded during the flora and vegetation survey of which the following eight occur within the Project area:

Shrublands

- S1: Open scrub of *Eremophila galeata* and emergent *Acacia aneura* var. *aneura* and *Acacia tetragonophylla* over *Ptilotus obovatus* var. *obovatus* and *Solanum lasiophyllum* over *Aristida contorta*, *Eriachne pulchella* subsp. *dominii* and other grass species on orange clay flats with variable quantities of quartz and other pebbles.

- S2: Open scrub of *Acacia aneura* var. *aneura*, *Acacia pteraneura* and occasional *Acacia tetragonophylla* over mixed *Eremophila* species and *Ptilotus obovatus* var. *obovatus* over *Aristida contorta*, *Eriachne pulchella* subsp. *dominii* and *Dysphania kalpari* on orange sandy/loam to clay/loam flats with occasional coverage of pebbles.

- S3: Tall scrub of *Acacia aneura* var. *aneura*, *Acacia ayersiana* and *Acacia tetragonophylla* over *Eremophila galeata* over *Ptilotus macrocephalus* over *Eragrostis pergracilis*, *Paspalidium basicladum* and other grass species and mixed herbaceous species on orange clay/loam flats and flood plains.

Woodlands

- W1: Woodland of *Acacia aneura* var. *aneura*, *Acacia ayersiana* and *Acacia tetragonophylla* over *Eremophila galeata* over *Ptilotus macrocephalus* over *Eragrostis pergracilis*, *Paspalidium basicladum* and other grass species and mixed herbaceous species on orange clay/loam flats.

- W2: Open woodland of *Acacia aneura* var. *aneura, Acacia ayersiana* and *Acacia tetragonophylla* over *Eremophila galeata* over *Ptilotus macrocephalus* over *Eragrostis pergracilis*, *Paspalidium basicladum* and other grass species and mixed herbaceous species on orange clay/loam flats and flood plains.

- W3: Mosaic of woodland to open woodland of *Acacia aneura* var. *aneura*, *Acacia ayersiana* and *Acacia tetragonophylla* over *Eremophila galeata* over *Ptilotus macrocephalus* over *Eragrostis pergracilis*, *Paspalidium basicladum* and other grass species and mixed herbaceous species and *Eremophila galeata* and emergent *Acacia aneura* var. *aneura* and *Acacia tetragonophylla* over *Ptilotus obovatus* var. *obovatus* and *Solanum lasiophyllum* over *Aristida contorta* and *Eriachne pulchella* subsp. *dominii* on orange clay/loam flats and flood plains.

Flow-lines

- C1: Tall scrub of *Acacia tetragonophylla*, *Acacia fuscaneura*, *Acacia craspedocarpa* and *Grevillea striata* over occasional *Eremophila galeata* over mixed grass and herbaceous species on flowlines with orange loam.

- Other
    - CD: Completely degraded vegetation. Cleared for bitumen roads (Mattiske Consulting 2011).

A total of 172 vascular plant taxa from 77 plant genera and 29 plant families were recorded within the Project area. The majority of taxa were recorded within the Fabaceae (29 taxa), Poaceae (22 taxa), Scrophulariaceae (17 taxa), Chenopodiaceae (16 taxa) and Amaranthaceae (13 taxa) families (Mattiske Consulting 2011).

No Threatened Flora species pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* and as listed by the Department of Environment and Conservation (2011) were recorded within the survey area. No plant species listed under the *Environment Protection Biodiversity Conservation Act 1999* (Department of Sustainability, Environment, Water, Population and Communities (2011) were found within the survey area (Mattiske Consulting 2011).

One potential Priority 1 species*, Euphorbia*? *sarcostemmoides* (P1), was recorded in the survey area, however as the specimen was immature and lacking key diagnostic characteristics the identification was not completed (Mattiske Consulting 2011).

A total of three introduced (exotic) taxa were recorded within the Project area. None of these are Declared Plants species pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* according to the Western Australian Department of Agriculture and Food (2008) (Mattiske Consulting 2011).

Ten plant communities were defined and mapped for the Project area. None of the communities defined are listed as Threatened Ecological Communities or Priority Ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (Department of Sustainability, Environment, Water, Heritage and the Arts (2011) or the Department of Environment and Conservation (2011) (Mattiske Consulting 2011).

On the basis of the review of the ten clearing principles under the *Environmental Protection Act 1986*, for which native vegetation should not be cleared, there appear to be no impediments from a botanical perspective for the proposed project developments (Mattiske Consulting 2011).

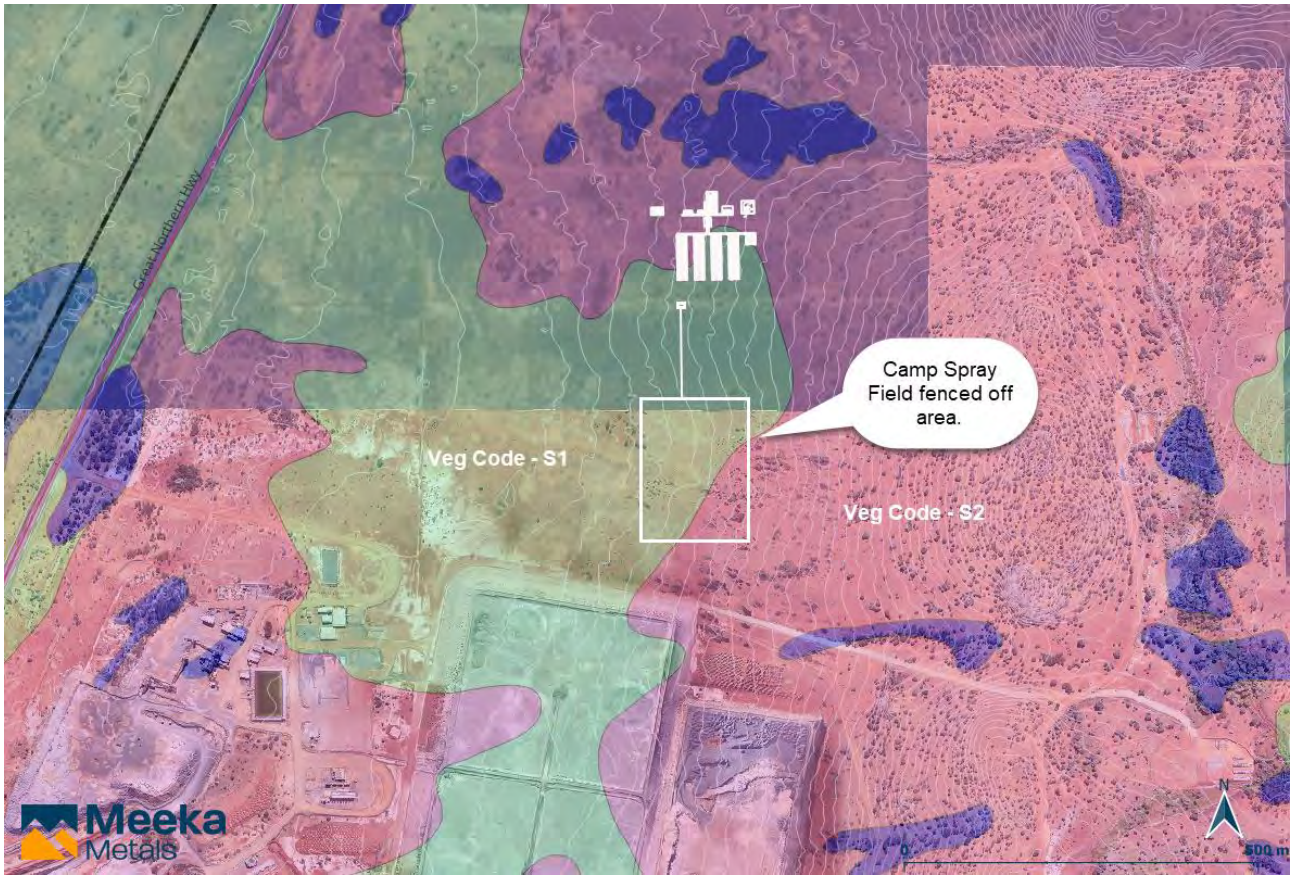

Figure 7 Spray Field with Local Flora and Contours

10.3 Terrestrial Fauna

10.3.3 Vertebrate Fauna and Short-Range Endemics (SRE)

Bamford Consulting Ecologists completed a fauna assessment, including desktop view and reconnaissance field survey, of the Mining Lease M51/870 application area encompassing the Project in December 2011.

The desktop survey identified 219 fauna species potentially occurring in the Project area. This comprised six frog, 68 reptile, 117 bird, 18 native mammal and ten introduced mammal species. A total of 72 fauna species were recorded during the field survey. This comprised 55 bird, seven native mammals, four introduced mammals, five reptile and one frog species (Bamford Consulting Ecologists 2012).

A total of 13 conservation significant species are considered likely to occur within the Project area (either as a resident or as a visitor on a seasonal basis). Two conservation significant species were recorded during the field survey (Australian Bustard – CS2 and Woolley's Pseudantechinus – CS3), with evidence of a species considered locally extinct also recorded (Western Pebble-mound Mouse – CS2). An additional species, the Bush Stone-curlew (CS2), was recorded from Meekatharra and is also likely to occur within the Project area. Targeted searching did not locate any further conservation significant fauna species (Bamford Consulting Ecologists 2012).

The faunal assemblage expected is typical of the Murchison region. Most fauna species occurring or expected to occur in the Project area are widespread but some species may have restricted or

habitat limited distributions, and some fauna species expected have declined in the region (Bamford Consulting Ecologists 2012).

Five major vegetation and soil associations (VSAs) were identified; of most significance were the rocky ironstone ridges and drainage lines. These VSAs are restricted in the area and are likely to support conservation significant and specialist species. However they occur mostly outside the proposed area of disturbance, with common and widespread VSAs covering much of the proposed pit and underground waste stockpile areas (Bamford Consulting Ecologists 2012).

Impacts upon fauna values are generally considered to be only minor, even upon the majority of significant species. This is because of the relatively small footprint of the Project which is located within widespread and common habitats, and the expected presence of a limited number of conservation significant species within the Project area. Conservation significant species of most concern, as they are restricted or likely to be impacted by the Project, include:

- Bush Stone-curlew (CS2)
- Grey Honeyeater (CS3)
- Long-tailed Dunnart (CS2)
- Woolley's Pseudantechinus (CS3).

10.3.4 Subterranean Fauna

Bennelongia Environmental Consultants (Bennelongia) was engaged to undertake a subterranean fauna desktop review and field survey to assess whether proposed mining for the Project may pose any conservation threats to subterranean fauna, which is a term used to refer to the invertebrate animals that occur at depth underground and have morphological adaptations to a subterranean life. These species are of conservation concern because many of them have very small ranges. Two types of subterranean fauna are recognised: troglofauna are air-breathing and live in unsaturated habitats at depth while stygofauna are aquatic and live in groundwater (Bennelongia 2011).

Information on subterranean fauna at the Project was compiled, and assessment undertaken, in two stages. The first stage consisted of desktop compilation of existing information on subterranean fauna and local geology, an assessment of the suitability of habitat at the Project for subterranean fauna, a preliminary assessment of the threats to subterranean fauna from mine development, and an evaluation of the need for field survey. The second stage consisted of field surveys to collect subterranean fauna, with a final assessment of the threats to subterranean fauna from mining based on the results of both the desktop work and field surveys (Bennelongia 2011).

The calculated risk to stygofauna from mining at the Project was determined to be moderate according to the desktop analysis. This was primarily attributed to the presence of classic stygofauna habitat within the Project area (aquifers of the Quaternary detritals of Murchison paleochannel) and the relatively small impact footprint of groundwater drawdown (1540 ha) (Bennelongia 2011). The extent of groundwater drawdown from mine dewatering was calculated by RPS Aquaterra during the completion of the dewatering assessment.

A total of 71 stygofauna samples were collected during subsequent field survey. This survey recorded 21 stygofauna species in the Project area; comprising Nematoda, Rotifera, Aphanoneura, Oligochaeta, Ostracoda, Copepoda, Syncarida and Amphipoda. Six of the 21 species were recorded from the impact footprint of the Project (Bennelongia 2011).

In terms of conservation threats, no stygofauna species are restricted to the detrital aquifers of the Project, and the integrity of the Priority 1 ecological communities (PECs) at Karalundi and Killara North calcretes will not be threatened by the proposed mining at the Project due to the relatively small impact footprint of groundwater drawdown (1540 ha) resulting from mine dewatering. Therefore, the proposed mining at the Project will not threaten stygofauna conservation values or the persistence of any stygofauna species (Bennelongia 2011).

The calculated risk to troglofauna from mining at the Project was determined to be low to very low according to the desktop analysis, due to the small impact footprint of the shallow pit excavation (3 ha). This was confirmed by the field survey consisting of 25 samples, during which a depauperate troglofauna community of two species (one isopod and one polyxenid) was collected. Neither species was recorded within the impact footprint and mining activities for the Project will not threaten their persistence (Bennelongia 2011).

10.4 Surface Hydrology

10.4.5 Regional Surface Water Hydrology

The water resources of the region can be described in terms of surface and ground water features. Surface drainage features can be further divided into two broad groups: the external drainage provided by the catchment areas of rivers that flow into the ocean, and the internal drainage of water courses that drain into salt lakes. To the east of a line running generally north to south, located between Meekatharra and Wiluna, lies the area of the internal drainage. Here, creeks and internal rivers drain surface water into numerous salt lakes. External surface water drainage is provided by a number of intermittent rivers (RPS Aquaterra 2011c).

The Project is located within the Murchison River catchment, which is the second longest river in Western Australia. Other major rivers draining this area into the Murchison River include the Yalgar River, Whela Creek and the Sandford and Roderick Rivers (RPS Aquaterra 2011c).

The catchment area of the Murchison River comprises an area of approximately 104,000 km^2 as defined by the Department of Water, but this reduces to an effective catchment of around 89,000 km^2 when the Lake Austin sub-catchment is excluded (inward draining catchment) (RPS Aquaterra 2011c).

The Murchison River extends about 550 km inland onto the Yilgarn Plateau and arises on the southern slopes of the Robinson Ranges, about 75 km north of Meekatharra. From there it flows in a westerly direction for about 130 km to its junction with the Yalgar River, then west for another 100 km before turning south-south-west for 120 km, at which point it is joined by the Roderick River. Another 70 km to the south-south-west it meets its other important tributary, the Sanford River. Over the next 100 km it makes a number of sharp turns, taking it about 70 km to the west. It then flows to the south-west, passing under the North West Coastal Highway at the Galena Bridge. Entering the Kalbarri National Park, it flows first to the north-west and then to the north, flowing through the Murchison Gorge, and passing through a number of tight bends known as the Z Bend and The Loop respectively. It eventually turns to the southwest, passing through one more dogleg before disgorging into the Indian Ocean at Kalbarri, the only settlement at any point along the river (RPS Aquaterra 2011c).

Large river gums exist along the river, although they are only present in the immediate vicinity of the main river channel, and do not generally extend into the flood plain (RPS Aquaterra 2011c).

Rain generally only falls in the upper basin during summer cyclones, so for much of the year, the Murchison River does not flow, having dry sandy river beds with occasional permanent pools. The

eastern reaches of the catchment contain large chains of salt lakes, which flow only intermittently. Water quality during floods is fresh, but turbid, while low flows are brackish and saline (RPS Aquaterra 2011c).

Streamflow is directly in response to rainfall and flows are ephemeral. Streamflow in the smaller creeks is typically of short duration, and ceases soon after the rainfall passes. In the larger rivers, which drain the larger catchments, runoff can persist for several weeks and possibly months, following major rainfall events, such as those resulting from tropical cyclones (RPS Aquaterra 2011c).

10.4.6 Local Surface Water Hydrology

The Project area lies within a catchment of approximately 520 km^2 that crosses the Great Northern Highway at a series of floodway/culvert arrangements. Bunds constructed parallel to Great Northern Highway channel local flow towards each respective floodway/culvert. The culverts generally comprise single 400 NB concrete pipes, and as such only have capacity for small flows. Larger flow events cross the road via the floodways. The majority of the catchment flows over the southern series of floodways (RPS Aquaterra 2011c).

The main catchment is around 31 km in length upstream of the mining area, and the main flowpaths have relatively flat average bed gradients of around 0.2%, and drain mainly in a north-westerly direction towards the mining area. The catchment typically has no defined incised creek bed, and as such, flow through the catchment is more likely to be in the form of sheet flow and with flow only during major rainfall events (RPS Aquaterra 2011c).

Once across the Great Northern Highway, the general direction of flow is in a north-westerly direction towards the Yalgar River. The Yalgar River is a 120 km long tributary of the Murchison River. It arises near the Great Northern Highway about 50 km north of Meekatharra, flowing about 80 km westward to a junction with its tributary, the Hope River. From there it flows north-north-westerly for about 40 km, before disgorging itself into the upper reaches of the Murchison River near the Carnarvon Meekatharra Road (RPS Aquaterra 2011c).

10.5 Groundwater

A staged hydrogeological investigation and dewatering assessment of the Project area was undertaken by RPS Aquaterra during 2011 (RPS Aquaterra 2012a). Investigations included an initial desktop review of the local hydrogeology, utilisation of the mineral drilling rig to complete a number of airlift tests across the mine site, packer testing of deeper lithologies and the ore body, and the drilling, construction and testing of a trial dewatering bore and associated monitoring bores.

Following the field investigations, groundwater modelling was undertaken, to assess the dewatering requirements and associated impacts relating to groundwater drawdown over the life of mine. Results from these hydrogeological and dewatering assessments are detailed below.

10.6 Hydrogeology

10.6.7 Regional Hydrogeology

Groundwater is likely to be present in the majority of lithologies in the Project area; however only those formations that contain effective porosity and permeability will yield significant quantities of groundwater. Key aquifer types that are likely to be present in the greater Project area are as follows:

- Shallow Alluvium

- Calcrete Aquifers
- Palaeochannel Sand Aquifers
- Fractured Rock Aquifers.

10.6.7.1 Shallow Alluvium

Alluvial deposits typically occur along the main drainages and are generally between 5 and 20 m thick, dependant on the size of the drainage system. This type of deposit usually consists of silty sand and gravels, and are characterised by ferruginisation and poor sorting of the predominantly quartz and ironstone grains.

Alluvial deposits form the upper portion of the Cainozoic sequence within the regional palaeodrainages. The shallow alluvial aquifers are generally unconfined, with a water table less than 5m below ground level (mbgl) and a saturated thickness typically between 5 and 15 m. The permeability is generally low. Typical yields from alluvium can range from 50 to 500 kL/d depending upon the local permeability.

The alluvial aquifers are generally fresh to brackish (1,000 to 4,000 mg/L TDS) becoming hypersaline (TDS >14,000 mg/L) towards salt lakes and in the lower parts of the regional drainage systems. Recharge to the aquifers is from irregular, episodic rainfall events and is estimated to be approximately 1% of the annual average rainfall (Johnson et al. 1999).

Due to typically low permeability and low bore yields, the alluvial aquifers are generally not directly utilised, other than for stock bores. The large groundwater storage in the aquifers can be utilised through downward leakage to the underlying palaeochannel sand and fractured rock aquifers, during regional aquifer depressurisation as a result of borefield pumping.

10.6.7.2 Calcrete Aquifers

Bodies of calcrete generally occur at the margins of present day salt lakes, and locally in some of the tributaries of the main drainages. The water table is generally shallow, less than 5 mbgl. The saturated thickness is highly variable (up to a maximum of 30 m thick) with an average saturated thickness of between 5 and 10 m. The areal extent of the calcrete aquifers is often limited although several large bodies occur to the north and east of the Project area.

Bore yields are variable depending on the nature and degree of karstic development. However, the calcretes can form locally high yielding aquifers where secondary porosity and high permeability are well developed. Long-term sustainable bore yields from the calcrete aquifers are typically around 500 kL/d although short term yields up to 1500 kL/d have been reported.

The groundwater is commonly brackish to saline (2,000 to 6,000 mg/L TDS), although local areas of fresh groundwater may occur where the calcrete receives enhanced groundwater recharge through direct infiltration from rainfall and surface run-off during intense rainfall events. Salinities in excess of 10,000 mg/L TDS have also been reported in some areas and groundwater may be hypersaline in the vicinity of salt lake systems.

Recharge rates of approximately 0.7% to 0.8% of rainfall have been estimated to the calcrete aquifers near Wiluna. Due to the nature of the calcrete aquifers, with highly transmissive zones generally close to the water table, this type of aquifer is susceptible to dewatering due to over-pumping. Recorded licensed abstractions from calcrete aquifers for mining use in the Goldfields region range from 0.2 to 3GL/year (Johnson et al. 1999).

Significant calcrete deposits have been mapped in the Yalgar River drainage to the north of the Project area.

10.6.7.3 Paleochannel Sand Aquifers

The palaeochannel sands form the most important aquifer in the Northern Goldfields, capable of providing significant groundwater supplies. The aquifers can be up to 1 km wide and 40 m thick in the trunk of major palaeochannels, while widths of several hundred metres may be found in tributaries. The thickness and presence of the palaeochannel sands is related to their origin with the thickest sand sequences occurring within and downstream of granitoid catchments and more clayey and finer sands within and downstream of predominantly greenstone catchments. Palaeochannel sands are usually inferred to be continuous along the main trunk drainages. The palaeochannel sand aquifers can be unconfined to confined below up to 80 m of clay.

Reported permeability ranges from 1 to 40 m/d, with an average of 10 m/d. There is relatively limited storage in the palaeochannel sands; however, long-term pumping induces leakage from the overlying lithologies and surrounding weathered/fractured bedrock. Reported short term yields from the palaeochannel sands are in the range 200 to 1,600 kL/d, as determined from pumping tests (Johnson et.al. 1999).

Groundwater in the main palaeochannels is generally brackish to hypersaline (TDS greater than 14,000 mg/L). However, lower salinity water (fresh to brackish, TDS 1,000 to 3,000 mg/L) can been found in the upper reaches of the palaeodrainages and in some tributaries.

The main drainage catchment of the present-day Yalgar River to the north of the Project, and its tributaries, both east and west of the Project area, have good potential for palaeochannel development.

10.6.7.4 Fractured Rock Aquifers

The fractured rock aquifers comprise greenstones, granitoids and minor intrusive rocks that are characterised by structurally (and weathered) induced secondary porosity and permeability. Groundwater occurs within the weathering profile and fractures in the basement rocks. In general, the greenstone rocks are more prospective for groundwater supplies than the granitoids, which are more homogeneous and less fractured. The greenstones form linear, arcuate belts of interbedded mafic and ultramafic volcanic, felsic volcanic and metasedimentary rocks (including chert and banded-iron formation). Within the weathering profile of greenstones, however, typically high clay contents limit groundwater development potential, whereas the weathering profile in granites is more productive due to high quartz content.

The fractured rock aquifers generally form minor local aquifer with fresh to saline groundwater (1,000 to 14,000 mg/L TDS). Yields from the fractured rock aquifers are highly variable and related to geological structure and rock type. The long-term sustainability of the fractured rock aquifer is constrained by their limited storage and availability of direct recharge. The fractured rock aquifers are recharged infrequently by rainfall and runoff from ephemeral drainages into open fractures and weathered zones.

10.6.8 Local Hydrogeology

The Andy Well ore bodies are hosted in high magnesium basalts that have been locally sheared and altered. Weathering has resulted in a regolith profile consisting of up to 10 m of saprolitic clays grading downward into sap-rock and oxidised meta-basalts. A thin veneer of detrital deposits overlie the saprolite.

A transition zone aquifer exists beneath the detrital cover and saprolitic clays and is represented by fractured and weathered lithologies both within the ore body, host rock and surrounding country rock.

Permeabilities will be enhanced in this zone particularly in the meta-basalt unit and deformed schists in proximity of the main shear and ore body, however some permeability enhancement is also likely in the surrounding granitic country rock. The transition zone aquifer can be further refined into an upper and lower aquifer unit.

Permeability generally decreases with depth below the transition zone and beyond around 100 mbgl the formations are very tight and no significant permeability has been observed.

Depth to water is relatively uniform and has been measured at approximately 5 mbgl across the proposed development area.

Groundwater quality in the Project area is expected to be fresh to slightly brackish. Some brackish groundwater (<4,000 mg/L total dissolved solids) may be expected at depth associated with mineralisation along the ore body; however this has not been indicated from current investigations.

Water samples collected across the ore body area show salinity as total dissolved solids (TDS) ranging between 990 and 1400 mg/L. pH levels for all water samples were slightly alkaline, ranging from 7.9 to 8.1.

The relative concentrations of the major ions for each water sample were found to be very similar in composition. All samples were determined to be of the sodium-chloride water type, typical of endpoint type groundwater with long residence times and little indication of recharge.

Deeper groundwater flow within the basement lithologies will be controlled locally by the dominant north to south trending structures and associated shearing and jointing. Shallower groundwater flow through surperficial sediments and weathering profiles will be influenced by local topography and drainage. Regional groundwater flow is expected be to the west into the Yalgar River and Murchison River drainage systems.

Groundwater recharge generally occurs as infiltration of rainfall and runoff with enhanced recharge occurring in areas of greater permeability such as sands and gravel, calcrete or fractured rock outcrops. Bestow (1992) has estimated rainfall recharge across the Murchison and Goldfields regions of Western Australia using the chloride mass balance method and found that estimates of rainfall recharge as a percentage of average annual rainfall can be correlated with shallow groundwater salinity as shown in Table 5. Based on this method, recharge in the vicinity of the Project is likely to be of the order of 2 mm per year. However, given the lack of outcrop and the presence of the saprolitic clay unit in the vicinity of the ore body, very little of this is expected to reach the local water table.

Table 5 Estimates of Rainfall Recharge (Bestow 1992)

Groundwater Salinity Range (mg/L)	Recharge (%)
<1500	0.9
1500 to 7,000	0.23
7,000 to 14,000	0.09
>14,000	negligible

10.7 Social Heritage

10.7.9 Aboriginal Heritage

The Project area is not identified on the Department of Indigenous Affairs (DIA) Aboriginal Heritage Inquiry System to be located within the boundary of any registered Aboriginal heritage sites.

An Aboriginal Heritage Survey was conducted for WMC over the M51/870 area by Dr Mana Waite in May 1997, the report titled *Report of an ethnographic survey in the Meekatharra area, Western Australia, Number 2*. This Aboriginal Heritage Survey did not identify any major site of cultural significance, although minor artefacts have been found.

The Mining Lease M51/870 tenement is covered by the Yugunga-Nya Native Title Claim Group who is represented by the Yamatji Marlpa Aboriginal Corporation (YMAC).

The relevant Aboriginal communities and stakeholders have been notified of the Project, including the following:

- Yamatji Marlpa Aboriginal Corporation (YMAC)
- Yugunga-Nya Native Title Claim Group
- Munarra Station Pastoral Lease Holder
- Department of Indigenous Affairs (DIA).

A thorough Aboriginal Heritage Survey was undertaken in coordination with YMAC (as the heritage provider and representative body for the Yugunga-Nya Native Title Claim Group) in February 2012 as part of this Native Title negotiation process (Native Title Co-existence Agreement). The Aboriginal Heritage Survey identified four Aboriginal heritage sites within the Project area. Doray has applied for consent from the Minister for Indigenous Affairs to disturb three of these Aboriginal heritage sites under Section 18 of the *Aboriginal Heritage Act 1972*. The other Aboriginal heritage site will be avoided.

10.7.10 European Heritage

The Project will not impact on any European heritage sites, as confirmed by the Australian Heritage Database and Heritage Council of Western Australia (HCWA) Places Database.

The Project area is remote with no existing or pre-existing (historic) human settlement nearby. The Karalundi Aboriginal Education Community is located approximately 10 km to the north of the Project area and the Killara Homestead approximately 25 km south-east, both of which are not registered European heritage sites.

11 Risk

11.1 Risk Procedure

The following tables have been developed for the purpose of risk assessment. The risk ranking process utilises a standard risk ranking table and is based on the perceived likelihood and consequence of an event.

Table 6 and Table 7 provide the definitions of Likelihood and Consequence. Table 8 is the risk ranking matrix. By selecting the appropriate Likelihood and Consequence, the risk ranking is determined from this table.

Risks associated with the Proposal were workshopped based on the work proposed and the various activities that would need to be undertaken to achieve this. The likelihood and consequence for each risk was evaluated without controls and was then revaluated with controls in place. The project aims to manage risk utilising the hierarchy of controls. Risks are evaluated and eliminated where possible, however if not, risks are then managed by substituting the risk, engineering a solution or finally administrative controls to manage the risk.

In undertaking the risk analysis component of the overall assessment, the approach focussed on addressing the 'credible worst-case consequence of the risk and the likelihood of the credible worst-case consequence occurring'. This approach was deemed the most appropriate due to the scale of the project.

Table 6 Risk Likelihood Table

Likelihood	Frequency	Description
Almost Certain	Twice or more per year	Event will occur during the Project
		High number of known incidents
Likely	Once per year	Event is likely to occur during the Project
		Regular incidents known
Possible	Once in 5 years	Event may occur during the life of the Project
		Occasional events known to occur
Unlikely	Once in 10 years	Event is not likely to occur during the Project
		Occurrences of event very unusual
Rare	Once in 20 years	Event will occur in exceptional circumstances
		Very limited or no known occurrences

Table 7 Risk Consequence Table

Factor	Insignificant	Minor	Moderate	Major	Severe
Biodiversity	Alteration or disturbance to an isolated area with no effect on habitat or ecosystem. Loss of an individual plant / animal	Alteration or disturbance to <10% of a habitat or ecosystem resulting in a recoverable impact within 2 years. Loss of multiple	Alteration or disturbance to 10- 40% of a habitat or ecosystem resulting in a recoverable impact within 2-5 years. Loss of <50%	Alteration or disturbance to 40- 70% of a habitat or ecosystem resulting in a recoverable impact within 5-15 years. Loss of >50%	Alteration or disturbance to >70% of a habitat or ecosystem resulting in a recoverable impact >15 years. Local loss of

	of conservation significance.	plants or animals of conservation significance	of known local plant or animal species of conservation significance	known local population of plant/animal species with possible loss of entire local population.	conservation significant or listed species. Extinction of a species.
Water Resources	Negligible change to hydrological processes, water availability or water quality.	Short-term modification of hydrological processes, water availability and quality within project tenure, but no change in beneficial use.	Medium-term modification of hydrological processes, water availability and water quality within project tenure, but no change in beneficial use. Short-term modification of hydrological processes, water availability and water quality outside project tenure, but no change in beneficial use.	Long-term modification of hydrological processes, water availability and water quality within project tenure, but no change in beneficial use. Medium-term modification of hydrological processes, water availability and water quality outside project tenure, with change in beneficial use	Long-term or permanent modification of hydrological processes, water availability or water quality outside project tenure, with impacts to a water-dependent environmental value and/or change in beneficial use.
Lands and Soils	Clean-up by site personnel, rectified immediately. Confined to immediate area around source.	Clean-up by site personnel, remediation within 1 year. Confined to operational area.	Clean-up by site personnel, remediation within 1-3 years. Minor impact outside disturbance envelope or minor impact to soil stockpiles.	Clean-up requiring external specialist, remediation within 3-10 years. Impact has migrated outside the disturbance envelope or contamination of soil stockpiles	Clean-up requiring external specialist. Remediation >10 years, or permanent residual impact. Impact outside the tenement boundary.
Rehabilitation and mine Closure	Site is safe, stable a non-polluting.	Site is safe, all major landforms are	Site is safe, and any stability or	Site cannot be considered safe, stable or	Site is unsafe, unstable and/or

	Post mining land use is not adversely affected.	stable, and any stability or pollution issues are contained and require no residual management. Post mining land use is not adversely affected.	pollution issues require minor, ongoing maintenance by end land-user. Post mining land use cannot proceed without some management.	non-polluting without long-term management or intervention. Post mining land use cannot proceed without ongoing management.	causing pollution or contamination that will cause an ongoing residual affect. Post mining land use cannot be achieved.

Table 8 Risk Matrix

Risk Matrix		Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	Almost Certain	medium	high	high	extreme	extreme
	Likely	medium	medium	high	high	extreme
	Possible	low	medium	medium	high	high
	Unlikely	low	low	medium	Medium	high
	Rare	low	low	low	medium	medium

11.2 Risk Assessment

Table 9 Project Risk Assessment

Risk number	Factor	Description of impact	Phase	Inherent Risk			Management Practices to be Implemented	Data Certainty	Residual Risk		
				Likelihood	Consequence	Risk			Likelihood	Consequence	Risk
1	Lands and soils	Leak of sewage between the village and the WWTP	Operations	Possible	Moderate	Med	Pipes installed by qualified plumbers. Pre-commissioning inspections	High	Rare	Moderate	Low
2		Leaks of treated effluent heading to spray field	Operations	Possible	Moderate	Med	Pipes installed by qualified plumbers. Pre-commissioning inspections	High	Rare	Moderate	Low
3		Rupture of raw water or sludge tanks	Operations	Possible	Moderate	Med	Exclusions zone for machinery around tanks. Spill kits and clean up immediately	High	Rare	Moderate	Low
4		Standing water at the Spray field	Operations	Possible	Moderate	Med	Spray filed installed as per design. regular inspections. Active management of spray field if	High	Unlikely	Moderate	Low

							standing water is seen				
5		Chemical spills	Operations	Possible	Minor	Med	Chemicals stored as per SDS. Chemicals not kept in large quantities. Spill kits for clean up	High	Rare	Minor	Low
6		Over topping of tanks leading to leaks	Operations	Likely	Minor	Med	High level alarms on tanks. Alarms checked as per maintenance routine (Table 11)	High	Unlikely	Minor	Low
7	Biodiversity	Excess clearing for WWTP	Construction	Unlikely	Minor	Low	Clearing produced in place and clearing signed off prior to commencement.	High	Rare	Minor	Low
8	Water Resources	Sewage contaminates groundwater	Operations	Unlikely	Moderate	Med	Pipelines checked and inspected before use. Physical separation between pipelines and groundwater	High	Rare	Moderate	Low
9		Sewage contaminates surface waters	Operations	Unlikely	Moderate	Med	Location of plant upstream of camp to prevent interaction with surface water flows. Diversion drains in place if required	High	Rare	Moderate	Low
10	Closure and Rehabilitation	Insufficient soils for closure	Closure	Unlikely	Minor	Low	Topsoils stripped before construction. Topsoil balance undertaken for the entire Mine	High	Rare	Minor	Low
11		Soils contaminated,	Closure	Unlikely	Minor	Low	Topsoils strred upstream of	High	Rare	Minor	Low

		leading to poor rehabilitation					potential flows. Bunding and drains installed if required				
12	General	Odour emissions from WWTP	Operations	Unlikely	Minor	Low	Odour is not an issue if plant is operating correctly. Regular checks of WWTP. Odour emissions register maintained, and complaints of odour investigated.	High	Rare	Minor	Low
13		Water and associated plant growth at the spray field attracts cattle and other animals	Operations	Likely	minor	Med	Spray field to have 2 strand fencing to prevent fauna ingress	High	rare	Minor	Low
14		Dust emissions during construction	Construction	Possible	Minor	Med	Clearing during periods of low wind.	High	Rare	Minor	Low

11.3 Monitoring and Management of Risk

Much of the risk associated with operating the plant is managed by the operations manual developed by Tristar. The Manul outlines the initial checks that should take place prior to operation and also specifies the ongoing maintenance ad associated checks that will ensure the operation of the plant remains optimal. Meeka will implement the operations manual and the maintenance checklist and will ensure those tasked with running the WWTP are educated in the requirements of the various plans and also have the skills to ensure these checks are done correctly.

The spray field has the potential to attract animals through the growth of new vegetation and the potential for standing water. The operations manual specifies that the spray field is checked for functionality weekly, however Meeka plans to implement a daily inspection to ensure that no standing water is seen. The spray field has been sized to manage up to 50kl per day, and will be operated at 35kl per day. The 1ha spray field with a 0.6ha additional contingency area, will cope with the wastewater load over various environmental conditions.

To ensure the WWTP is operating as per the manufacturer's specification, Meeka will undertake the monitoring for the parameters outlined in Table 3. During the commissioning and early operation of the WWTP it is likely that the system will require ongoing checks and refinement. During this phase of the operation of the WWTP sampling will be occur more regularly to assess whether the system is working correctly, or whether the system required adjustment. A commercial flight between Meekatharra and Perth operates on Monday, Wednesday and Friday, and this will be used to transfer samples from site to the lab. Samples will be taken on these days, during commissioning and the first month of operating, before the sampling effort is reduced. Once the plant appears to be running as per the design specifications, sampling will be reduced to weekly for a further one month period to ensure the plant operation remains within the desired parameters, and after this month sampling will be reduced to a monthly effort.

The volume of effluent sent to the spray field will be recorded on a monthly basis. The WWTP is fitted with a flow meter which will measure all water sent to the spray field. A monthly recording will be sufficient to ensure the plant is treating the volume of water as per the operating licence. Should this be insufficient the approval will be revised.

12 Commissioning Plan

Commissioning of the plant is requested as part of this works approval application. A commissioning plan and checklist has been developed by Tristar and is shown in Table 10. The plan and checklist are also available in Appendix 1.

Table 10 Commissioning Plan and Checklist

Item	Description	Completed By
1	Check all piping and valves for leaks	
2	Check operation of valves	
3	Fill tanks with water and check tank for leaks	
4	Operate aerators to ensure that evenly distributed fine air bubbles are produced	

5	Check overflows	
6	Ensure the irrigation tank outlet valve is 100% open	
7	Prime balance pump by loosening the air release screw on the pump casting	
8	Turn balance pump on and check the pump operates correctly. Confirm the flow rate and pressure as per the design specifications	
9	Prime decant pump by loosening the air release screw on the pump casting	
10	Turn decant pump on and check the pump operates correctly. Confirm the flow rate and pressure as per the design specifications	
11	Prime sludge pump by loosening the air release screw on the pump casting	
12	Turn the sludge pump on and check that the pump operates correctly. Confirm the flow rate and pressure is as per the design specifications	
13	Prime recirculation pump by loosening the air release screw on the pump casting	
14	Turn reticulation pump on and check that the pump operates correctly. Confirm the flow rate is as per the design specifications	
15	Prime the sodium hypo dosing pump by loosening the air release screw on the pump casting	
16	Turn sodium hypo dosing pump on and check the pump operates correctly. Confirm the flow rate is as per the design specifications	
17	Prime the irrigation pump by loosening the air release screw on the pump casting	
18	Turn irrigation pump on and check the pump operates correctly, and the water meter records the flow of water. Confirm the flow rate is as per the design specifications	
19	Place PAC carboy in bund	
20	Turn PAC dosing pump on and check that the pump operates correctly. Confirm the flow rate is as per the design specifications	
21	Place sucrose carboy in bund	

22	Turn sucrose dosing pump on and check that the pump operates correctly. Confirm the flow rate is as per the design specifications	
23	Place sodium hypochlorite carboy in bund	
24	Turn sodium hypo dosing pump on an, set ORP and inspect the dosing line	
25	Inspect all tank float switches and check pump start/stop and high level alarm operates	
26	Check operation of sprinklers i.e. spray diameter and rotation	
27	Eyewash station- ensure backflow prevention device has been fitted. Purge potable line by opening hose tap located next to the safety shower, run for 30 seconds. Operate safety shower and eyewash together so as to visually check the cross flow on the eyewash is sufficient. Green light above eyewash must be operational	
28	Instruct and train all personnel involved with maintaining plant. SDS sheets for use of PAC, sucrose and sodium hypochlorite to be in a position for visual inspection at any time. Train in testing procedures to keep the plant at satisfactory levels.	
29	Provide personnel with operations manual for all components of the wastewater treatment plant.	
30	Visual inspection of surrounding areas of the plant that includes: - All exposed material is painted - No water leaks - No damage to any components and shed - Earthworks area is clean with no trip hazards - All labels are in correct places including hazard signs for chlorine and confined space entry - Site rubbish has been removed	

13 Operating Plan

The WWTP will be operated as per the Tristar operations manual (Appendix 1). The following maintenance will be required to ensure the ongoing operation of the plant to ensure efficient wastewater treatment (Table 11).

Table 11 Plant Maintenance Schedule

Operational and Preventative Maintenance	Frequency

	Daily	Weekly	Monthly	Yearly	As required
Remove any Floating Solids	X				
Waste Sludge per results every settle period			X		
Inspect and paint any damaged/exposed surface to prevent rusting				X	
Check operation of level switch	X				
Irrigation Tank					
Observe quality of final effluent	X				
Check for leaks around valves and fittings	X				
Check for valve leaks	X				
Remove any floating solids	X				
Check scum accumulation level at inlet baffle		X			
Inspect and paint and damaged/exposed surface to prevent rusting				X	
Check operation of level switches	X				
Check operation of visual alarm	X				
Pumps					
Check operation of balance pump	X				
Check operation of PAC dosing pump	X				
Check operation of Sucrose dosing pump	X				
Check operation of decant pumps	X				
Check operation of sludge pumps	X				
Check operation of reticulation pumps	X				
Check operation of sodium hypochlorite dosing pump	X				
Check operation of irrigation pump	X				
Check PAC carboy level	X				
Check PAC dosing lines	X				
Check sucrose carboy level	X				

Check sucrose dosing lines	X				
Check hypochlorite carboy level	X				
Check hypochlorite dosing lines	X				
Check operation pump dosing and discharge isolation valves	X				
Check for blocks in suction lines	X				
Check pumps for clogging or near clogging condition	X				
Clean suction piping of pumps					X
Lubricate pump bearing as per manufacturer recommendations					X
Check pump motors for overheating	X				
Motors					
Check electrical leads			X		
Inspect circuit breakers, fuses and resets			X		
Check control panel indicators			X		
Spray Field					
Check system functionality		X			
Dripper line system flushing	Every three months				

14 Fee Calculation

The DWER fee calculator for works approvals was accessed for calculating the fee associated with this works approval application. The fee for a Category 85 WWPT was calculated to be 24 fee units, totalling [redacted]

15 Reporting

All records will be kept on the Meeka Project server and will be available upon request. The results from the monitoring will be reported on in the Annual Licence Report and the Annual Compliance report.

16 Conclusion

The Operation of the WWTP at the Andy Well Village can occur with minor risk. Meeka has purchased a plant that has operated previously and was operated in accordance with Western Australian approvals. The plant was found to operate within the parameters of Table 3 and will be operated accordingly again. The Installation, Operation, and Maintenance manual will be followed, which was successful at Kallium Lakes and will be successful at Andy Well.

17 References

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18 Appendices

18.1 Appendix 1

Kallium Lakes 35kl/day Wastewater Treatment Plant, Installation, Operations and Maintenance Manual